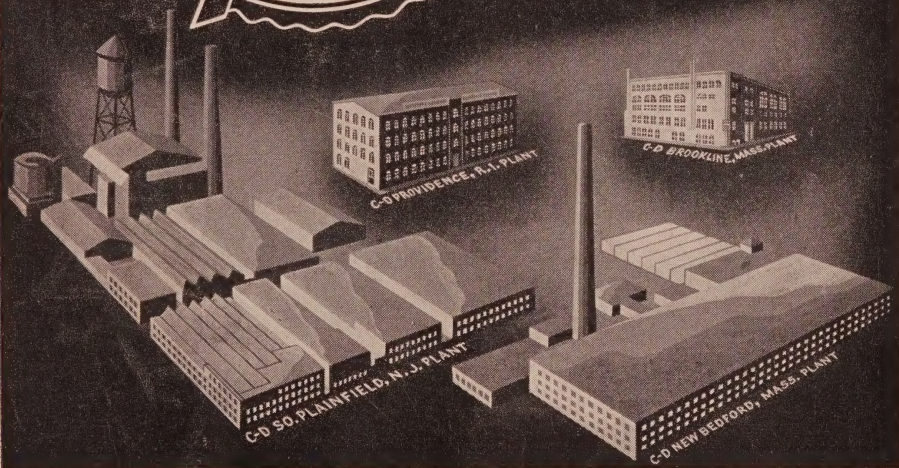


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Vol. 15

FEBRUARY, 1950

No. 2

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# TRANSISTOR CIRCUITS

Most radio experimenters now know something about the transistor, which more properly is called the **germanium triode**. Several theoretical articles describing this new crystal device have appeared in the popular radio magazines. Since transistors recently have become available commercially, interest is centered at this time on practical circuits in which they may be employed. This article describes several such circuits which have been tested by the author.

## Characteristics of the Transistor

The transistor is closely related to its parent, the germanium crystal diode. The main difference between the two is that the transistor has two whiskers making point contact with a tiny germanium wafer, while the ordinary crystal diode has only one. One of the whiskers of the transistor is biased with a small positive voltage and acts very much like the control grid of a triode tube. It is called the **emitter**. A much higher negative voltage is applied to the second whisker, called the **collector**, which is similar to the plate of a triode tube. The germanium wafer or "crystal" is the common electrode of the device and is comparable to the cathode of a tube. In one type of transistor construction, the points of the two whiskers rest upon the germanium surface a small distance (approximately 0.002 inch) apart. Figure 1 (A) shows the circuit symbol for the transistor.

An audio- or radio-frequency signal may be applied to the transistor input circuit in series with the emitter bias voltage and an amplified signal taken from the transistor output circuit. The transistor thus becomes a crystal amplifier. One method of injecting and extracting signal would be to connect the secondary winding of an input transformer between the positive terminal of battery  $B_1$  and the emitter, and connecting the primary

winding of an output transformer between the negative terminal of battery  $B_2$  and the collector. Because the transistor is a germanium device showing the conduction characteristics (positive and negative) characteristics of the crystal detector, large currents flow through the positive whisker and

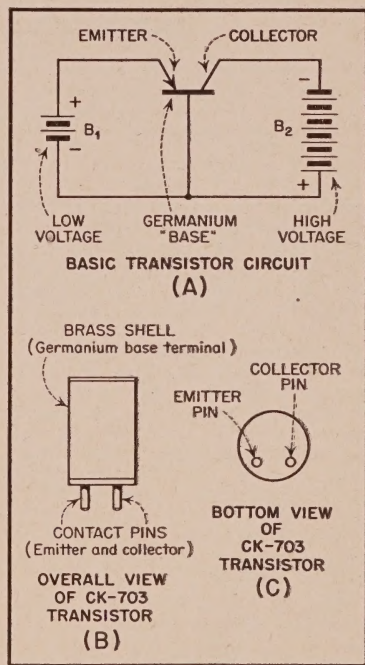


Fig. 1.

small currents through the negative whisker. This means that the transistor amplifier will have a low-impedance input circuit and high-impedance output circuit, which is quite the opposite of tube amplifier circuits.

The transistor which has been tested by the author is the new Raytheon



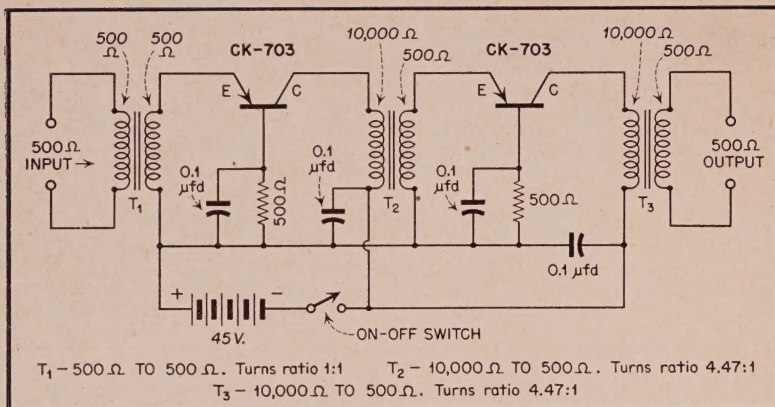


Fig. 2.

CK-703 crystal triode. Sketches of the CK-703 appear as Figures 1 (B) and 1 (C). The CK-703 is a small cylindrical unit, slightly larger than  $\frac{1}{4}$  inch in diameter and 0.65 inch long. Its outer envelope is a brass shell to which the germanium crystal is connected internally. The two whiskers are connected to tiny base pins mounted near the circumference of the base. Wire connections may be made directly to the shell and pins, but must be attached without soldering, since the application of heat is apt to damage the transistor. Or the user may construct a small spring-contact socket, similar to a miniature tube socket, into which the transistor may be inserted.

The CK-703 is listed as a medium mu triode designed for service in a. f. and r. f. amplifiers at frequencies up to and including the video range. For typical operation, the following characteristics apply: Collector voltage -30 v., emitter voltage 0.2 v., collector current 2 ma., emitter current 0.75 ma., transconductance 5000 micromhos, collector impedance 10,000 ohms, emitter impedance 500 ohms, average power output 2 milliwatts (at 50 microwatts input power to the emitter), average power gain 16 db.

The CK-703 is a small, lightweight device which, with hearing-aid batteries, can be made the basis of subminiature portable electronic devices. It is ready for operation as soon as the power is switched-on, there being no filaments to heat up, and its inter-electrode capacitances are very small.

### Audio Amplifiers

Figure 2 shows a 2-stage transistor audio amplifier with 500-ohm input and 500-ohm output. With good transformers, this arrangement will give approximately 30 db. gain with up to 2 milliwatts output power.

A single 45-volt battery (or 45 volts d. c. obtained from a selenium rectifier-type power supply with filter and voltage divider) will suffice. The positive emitter potentials are obtained as the voltage drop produced by the flow of collector currents through the 500-ohm base ("cathode") resistors. It may be necessary to adjust the values of these resistors somewhat, in order to compensate for individual differences in transistors.

The required transformer turns ratios for the required impedance transformations are given in Figure 2. Any transformers satisfying these requirements may be used, however

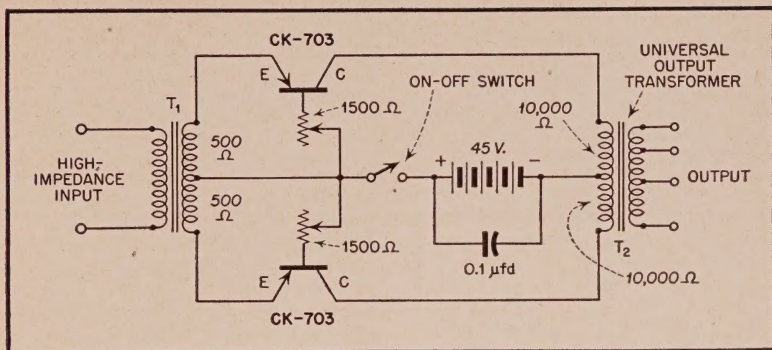


Fig. 3.

most experimenters will prefer miniature transformers in company with the small transistors. Transformers of the ouncer and sub-ouncer types are applicable. A variation of the scheme which will work perfectly well when the amplifier is not to be inserted into a 500-ohm line, consists of employing a high-impedance input winding in  $T_1$  and a tapped secondary winding in  $T_2$ . In this way, high-impedance input may be obtained, and the output may be matched to any one of several desired load devices.

There is sufficient voltage drop due to the primary resistance in transformers  $T_2$  and  $T_3$  and in the base resistors to reduce the battery voltage to a safe value before it is applied to the collectors. The current drain is low and will insure long battery life, provided the ON-OFF switch is opened when the amplifier is not in use.

Figure 3 shows a pushpull audio amplifier employing two CK-703 transistors. The input transformer,  $T_1$ , is a step-down unit affording rela-

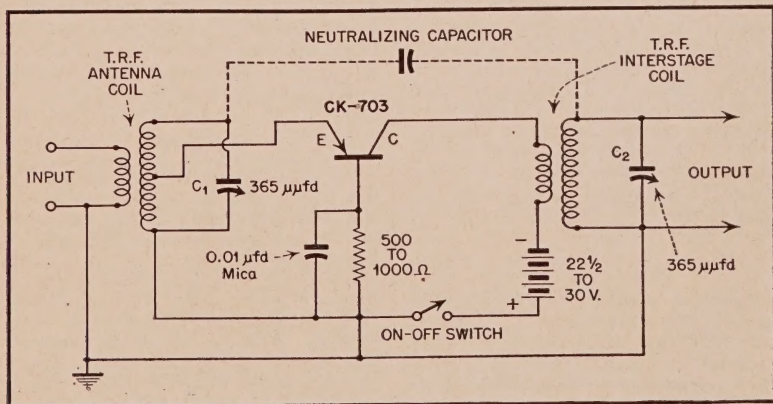


Fig. 4.



tively high-impedance input. The primary of  $T_1$  may, for example, be 10,000 ohms. The output transformer,  $T_2$ , has a tapped output winding for matching the output circuit to any one of several desired load devices, such as headphones, high-resistance output meter, loudspeaker voice coil, etc.

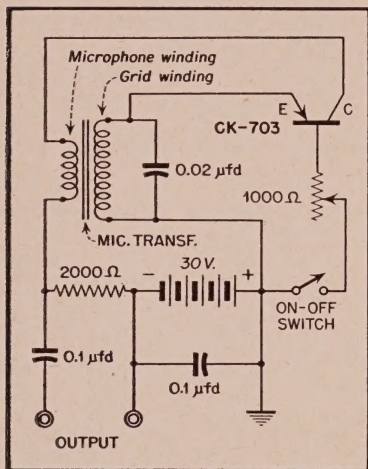


Fig. 5.

A separate base resistor is recommended for each transistor, as shown in Figure 3. Each of these is a 1000- or 1500-ohm rheostat, preferably wire wound. Each rheostat is adjusted separately to compensate for individual differences in the transistors. The best adjustment will give maximum power output (which should be in the vicinity of 4 milliwatts) with lowest distortion and with no tendency toward oscillation or singing.

### R. F. Amplifier

Figure 4 shows a tuned radio-frequency amplifier suitable for broadcast band operation. Standard t. r. f. coils and a 2-gang 350- or 365-uufd. tuning capacitor are employed. Several such stages may be operated in cascade in the usual manner. Note

that the emitter of the CK-703 is tapped down the secondary coil. This tap, which must be made by the experimenter approximately  $\frac{2}{3}$  down the coil, accommodates the low-impedance emitter. Its exact position may have to be determined experimentally because of some variation in transistor emitter characteristics. If several r. f. amplifier stages are cascaded, each emitter must be tapped down the secondary coil in the same manner.

If the circuit oscillates, the neutralizing capacitor must be added, as indicated by the dotted lines. This capacitor should not be more than about 2 micromicrofarads and can consist of two short parallel pieces of insulated wire run into a length of spaghetti tubing. If neutralization is not obtained readily, connect the "output" end of the neutralizing capacitor to the opposite terminal of the output transformer secondary for proper phasing. In some circuits, it may be necessary to alter the value of the cathode bypass capacitor in order to remove oscillation, even after installation of the neutralizing capacitor.

Transistor r. f. amplification appears to fall off sharply at frequencies higher than the standard broadcast band, so that the number of stages must be increased for a given amount of amplification as the frequency is increased. Since the transistor emitter circuits are low-impedance, tuning is broader than with tubes.

### Oscillators

Figure 5 gives the circuit schematic of a transistor audio oscillator employing tickler feedback. This unit will give an output of 10 volts RMS across a 2000-ohm load.

The frequency of oscillation is determined almost entirely by the L-C combination comprised by the grid winding of the microphone-type transformer and the fixed capacitor in parallel with it. In the author's tests, a U. T. C. Type S-7 transformer was

used with a 0.02-ufd. capacitor, as shown in Figure 5, to obtain a frequency of 450 cycles. Other frequencies may be obtained simply by switching-in higher or lower values of capacitance.

The 1000-ohm rheostat in the cathode circuit must be adjusted to give best stability and lowest distortion. If oscillation is not obtained at any setting of the rheostat, the connections to the microphone winding of the transformer should be reversed for proper phasing.

While several types of transistor audio oscillator circuits have been suggested by various writers on the subject, the author found the tickler feedback arrangement shown in Figure 5 to be the most foolproof. While the distortion present in the output of this circuit is relatively high, a characteristic of the simple tickler-type a. f. oscillator, the simplicity and small size of the unit recommend it nevertheless for such portable applications as a pocket-size oscillator for field tests. It is suitable also as a simple signal injector for audio amplifier circuit tracing and trouble shooting. Where better purity of output waveform is desired, a suitable low-pass filter may be connected in the output circuit to attenuate harmonics.

Figure 6 shows a radio-frequency oscillator in which oscillation is obtained through a cathode impedance common to both emitter and collector circuits. This oscillator gives a strong output signal in the i. f. and standard broadcast bands, but its output falls off rapidly as the operating frequency is increased beyond about 2 megacycles.

The frequency is determined by  $L_1$  and  $C$ . Coil  $L_1$  (for broadcast band operation) may be a standard t. r. f. broadcast coil, and  $C$  a 350- or 365-uufd. midget tuning capacitor. Coil  $L_2$  is a small pickup coil consisting of 5 turns of cotton-covered wire close-wound around one end of  $L_1$ .

The 10,000-ohm emitter rheostat is adjusted to a point where the circuit breaks into oscillation and then advanced slightly beyond that setting.

This r.f. oscillator may be modulated by the audio oscillator shown in Figure 5. To accomplish this, connect the audio oscillator output terminals in series with the ON-OFF switch and the lower end of r.f. oscillator coil  $L_1$ .

### Transistor Noise Level

The transistor exhibits a higher noise level than a triode tube. This normal condition is evidenced by a light hissing sound which is particularly evident in the audio oscillator and audio amplifier. Unless a num-

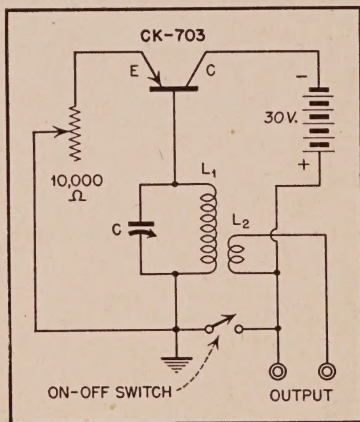


Fig. 6.

ber of stages are cascaded, however, the inherent noise is not objectionable.

### Transistor Polarity

Every precaution must be observed with respect to connecting the transistor properly in the circuit, and of maintaining proper battery polarity. The device is almost certain to be burned out if the collector battery is reversed, even for a short time.





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**SALE OR TRADE**—Pair of Army Sig. Corps Walkie Talkies, 75 mtr. band, with batteries, \$45. Feiler sig. tracer, \$8. Jackson cond. checker, cost \$54, take \$20. Payne Radio Service, 1328 13th St. Pl., Des Moines, Iowa

**SELL**—LS-3 speaker, perfect, used with BC-348, \$2.50. Mark II new, complete, \$45. 872 tube, \$1. Sockets for 872, 60c each. 40 mtr. 50w. Center link coils, 50c, new. G. F. Gnandt, Creek Valley Park, Wellington, Ohio



**TRADE**—Scott receiv. SLR-H for good 33 $\frac{1}{4}$  transcription turntable & LP pickup arm. C. R. Evans, Birch Lane, Mountain-side, N. J.

**WANTED**—NRI tester built from NRI experiments, with or without batteries, state price. J. W. Bentley, 817 29th St., Columbus, Ga.

**TRADE**—Riders man. 5, 6, 7 & Superior 1230 sig. gener., all good cond. for Halli-crafter S-40-A, NC-57 or other comparable communications receiver. Bryan Hall, DeKalb, Texas

**TRADE**—Jeff Travis \$90 Marine and broadcast 3-way radio, PE157 portable power supply, 135v/90v/1.5v, from 2v rechargeable batt. Want wire tape recorder. A. Haftel, 1651 Montgomery Ave., Bx 53, N. Y.

**WANTED**—Saturday employment. Graduate radio-TV student. Money not too important. Slight experience. Own radio telephone license. Milton Pomerantz, 14-68 Bryant Ave., Bx. 60, N. Y.

**SELL OR TRADE**—Hammarlund "FOWR-20" xmtr Schematic 2 calib. xtals, coils for 10 & 40 meters. \$43 or will swap for Heathkit scope. J. F. Kaiser, 1013 S. Second St., Philadelphia 47, Pa.

**FOR SALE OR TRADE**—A.C. 3 tube signal tracer with probe, excellent condition, \$10. Want radio accessories, tubes, speakers, chassis, sockets condensers, etc. Jesse Ramey, 1309 Leeson Ave., Cadillac, Mich.

**SELL OR TRADE**—Complete NRI radio TV servicing course with answers. Perfect condition. Also Heath kit signal tracer. Used a few months. E. J. Kostelnak, 33-57 W. 62nd St., Chicago 29, Ill.

**WANTED**—National 1-10, SW3, SW45, FB7, FBX receivers; Stancor 10-P xmtr or similar. W. E. Miller, 449 E. 14 St., New York 9, N. Y.

**TRADE**—About 525 serviceable tubes, all types. Want Heathkit scope, preferably model 05, or Riders manuals 1 to 5 (not 1 to 5 abr). W. G. Cordell, 3921 Shields Blvd., Oklahoma City 9, Okla.

**FOR SALE**—Control heads for motorola sets, for all cars. Manual and automatic. What do you need? Also Buick Custom auto set for '40, '41, '42 Buicks. Perfect condition, \$35. Leading Radio & Appliance Co., 158-160 E. 3rd St., Mount Vernon, N. Y.

**SALE OR TRADE**—Garrard RC-60 changer like new. Want Meissner 8-C tuner or \$30. S. Bryan, 2104 Dayton St., Silver Spring, Md.

**FOR SALE**—Revere tape recorder used two weeks for demonstration only, \$129. Money order takes it; full factory guarantee. H. Heller, 12326 Fairport Ave., Cleveland 8, Ohio

**FOR SALE**—7" Transvision TV with magnifier in good shape. Works fine. Make offer. Greiner Radio Service Co., 299 S. Elmwood Ave., Buffalo, N. Y.

**FOR SALE**—New Riders manuals 10, 12-15, \$60 takes all. A-1 Refrigeration Service, 8712 E. Flower, Bellflower, Calif.

**FOR SALE**—Sweep generator, assembled Heath kit. Needs adjustment. \$15. Instructions included. L. Matushefske, 2 Elmont Rd., Elmont, L. I., N. Y.

**FOR SALE**—New books at reduced prices, Industrial Electricity, parts 1 and 2 by Dawes, \$4; High Frequency Measurements by Hund, \$3. Also others. Ship C.O.D. at 40% off list. Leon Medler, 21-09 Daly Ave., Bronx 60, N. Y.

**FOR SALE**—Counter type tube tester, Triplett, perfect condition, tests all tubes. Approved model A100 sig. generator, perfect condition, both for \$45. Back number QST, Electronics, Radio News sold cheap. Leo Raboy, 1801 Longfellow Ave., Bronx 60, N. Y.

**WANTED**—RCA audio chanalyst. State what is wanted in trade, guns, cameras or test equipment. G. W. Deuchler, 1510 Monroe St., Omaha 7, Neb.

**SELL OR SWAP**—Riders P.A. manual in original wrapping, never used, for best offer over \$12 or new RCA 45 rpm record player, model 9-J-Y. Lad Z. Sajor, 60 Maryton Rd., White Plains, N. Y.

**SALE OR TRADE**—Meissner Analyst, like new. Best offer. Trade for Riders manuals. M. J. Yakimovich, 28 S. Stowell St., Worcester 4, Mass.

**FOR SALE OR TRADE**—McCoy "19" model airplane motor with 2 props. Glow plug operation. Would like used pocket ohmmeter in good condition or sell for \$10. Glynn P. McCready, P.O. Box 314, Dunsmuir, Calif.

**FOR SALE**—15 watt amplifier complete with tubes at the right price. Carrs TV Center, 15-17 Kelley Sq., Worcester 4, Mass.

**WILL TRADE**—for good condition 5" scope with all data, unused Royal tank type vacuum cleaner complete with attachments or Philco radio phono. model 1201 new condition. H. T. Wills, Valatie, N. Y.

**FOR SALE**—BC 1068-A, \$25; BC 404-C, \$20; National 1-10, \$20; SW-3, \$20; Converted 522 rec., \$50. Want tape recorder. P. L. West, 3202 18 St. N.W., Washington 10, D. C.

**FOR SALE**—Tube tester by Superior Instrument Co., model 1240, good as new, any reasonable offer. Williamson Radio Service, Cooper, Texas

**WILL SWAP**—Meissner 8C FM tuner, like new, for vacuum tube voltmeter or signal generator in good working condition. Steve's Radio Service, Box 342, Terryville, Conn.

**FOR SALE**—Following test equipment: Supreme 504-B tube/set analyzer, Electronics Bridge, Radio City 801-M, Supreme 333, pocket VOM, FM/TV signal generator. Franz Radio-Vision, 1527 Liberty St., Erie, Pa.

**FOR SALE**—Complete Lincoln engineering course in radio, like new, \$8.50. Traveler 3-way portable, needs minor repairs, \$6.50. Like new. F.O.B. Kewanee. Radio Elect. Service, 111 N. Burr Blvd., Kewanee, Ill.

**SWAP**—Have Masco portable disc recorder, like new, all accessories, mike, 30 blanks, etc. Want Dejur or similar photo enlarger and accessories. Joel Winton, 138-14 78 Drive, Kew Gardens Hills, N.Y.

**SELL OR TRADE**—G. E. luminous tube transformer, like new, primary-110v, secondary-12,000v. Make offer or what have you? Ralph Vignola, 73-20 Juniper Rd., Middle Village, Queens, N. Y.

**SWAP**—Want typewriters, Riders manuals, old U. S. coins, dollar size foreign silver coins, small oscilloscope, soldering gun, F.M. signal gen., fine signal tracer, test speaker, parts, air compressor. I have typewriter, gun, watch, etc. for trade. G. R. Calvert, Rt. 2, Box 123A, Winter Haven, Fla.

**WANTED**—Radio store and service business. Please send description and details to H. Latko, 1922 Dickens, Chicago, Ill.

**SWAP**—Pair of good binoculars, rubber molds, books and courses. Want SCR-625 mine detector. John Haynes, Doe Run, Mo.

**FOR SALE**—BC-654, \$10; GI dual speed recorder, R-90L, \$20; power pack 300 DC at 65 MA tap—22.5-90-180v. for 110-60 cy. AC, \$5 complete; radio physics course, Ghirardi, \$2. M. L. Bowser, 777 Huber St., Johnstown, Pa.

**SWAP OR SELL**—SX25 rcvr, Dumont 274 scope. Want SX28A, NL183, SX42. Herbert Halbig, Box 1161, Tupper Lake, N.Y.

**WANTED**—All kinds of radio test equipment, including tube tester and signal tracer. Will also pay the asked price for a 25D8GT or metal tube. Bud's Radio & Elect., P.O. Box 5, New Florence, Pa.

**WANTED**—Hickok model 510X tube tester or equivalent. Hickok model 177X or 18-8X sig. gen. With manuals and charts. Give lowest price and condition. Ferdinand Lurski, 207 Munn Ave., Irvington 11, N. J.

**FOR SALE**—Philco car radio, A-1, new vibrator and buffer. Custom fit for '41-'46 Chrysler products, \$25. C. Lange, 168 Clarencedale Ave., Youngstown, Ohio

**FOR SALE**—Scott philharmonic 30 tube, \$225; Meissner 9-1091, AM-FM, metal cabinet, \$125; new Jensen 15" HNP51, in cabinet, \$100; G.E. JFM90 FM tuner converted, \$15. J. C. Converse, 445 E. Grand Blvd., Detroit 7, Mich.

**FOR SALE**—Supreme tube and set tester, Supreme audolyzer, Solar capacitor analyzer, signal generator, ATR eliminator, tubes, condensers, Photo Facts, etc. Steven Goydich, Market St., Tresscow, Pa.

**SELLING OUT**—Triplett 3433 FM-AM sig. gen., \$125; Precision EV-10 VTVM, \$55. Both instruments shipped F.O.B. Milton Kalashian, 2 Congress St., Newburyport, Mass.

**FOR SALE**—Riders manuals, 1-15, in new condition. Best reasonable offer. V. Luban, 214 E. 58 St., New York 22, N. Y.

**FOR SALE OR TRADE**—2 Altec Lansing 400B 12 watt 8" speakers. Want suitable test equipment. C. H. Harris, 27 Arcadia Rd., Old Greenwich, Conn.

**WANTED**—Used Hi-Fidelity amplifier, 10 to 20 watts. Such as the Scott or Brook, etc. Chas. Carlisle, 378 4th Ave., San Francisco 18, Calif.

**FOR SALE**—High precision VTVM with zero center ohm's for FM alignment. Eico model 221K in original carton \$45. Don's Radio Ser. 250 High St., Portland, Me.



**FOR SALE**—Riders manuals 8-15 incl. and Sam's Fotofact sets 1 to 30 in three binders. John Blackwood, 128 E. 11th St., Hutchinson, Kan.

**WANTED**—Riders manuals 9 and 10, 12-18. Also Hickok tracer meter, good VTM and capacitor analyzer. State price and condition. Harold Zvacek, R.F.D. 2, Cedar Rapids, Iowa

**TRADE OR SELL**—18 and 12 watt systems. First less speaker, second has 12" speaker. Either, \$12, or will trade for 3 speed motor or LP arm. Edwin Androski, 18 Dover St., Paterson, N. J.

**TRADE**—Model 909 sweep generator and B.C. 221 freq. meter for tube tester, 906 generator, 10HP4 tube or TV set. A. H. Gates, 13146 Turner Ave., Detroit, Mich.

**FOR SALE**—Riders manuals 1-5 inclusive, perfect condition. Also one Master intercom, Bogen, new. C. T. Fisher, 3936 Ames St., Washington 19, D. C.

**WANTED**—Several Pilotuners, good condition. Will swap 2 mechanically incomplete but electrically O. K. APR-4 tuning units, 80-300 and 300-1000 mc, for one covering 2000-4000 mc. L. E. Kulberg, 64-13 Buchanan St. NE, Washington 19, D.C.

**WANTED**—National receiver, model NC100 or model NC200. Also used Pilot FM tuner. J. E. Smith, Montezuma, Ga.

**WANTED**—Hallicrafters S-59 or S-56, Webster changer and 12" coaxial speaker, either as a unit or separately. Jack Millick, 269 Mather St., Oakland 11, Calif.

**WANT**—Rec. SX24, NC101, Howard 438, or similar in perfect condition. Have 3-way BC portable, Millen R9'er, other valuable items. G. Samkofsky, 527 Bedford Ave., Brooklyn 11, N. Y.

**FOR SALE**—7" TV, \$35; cabinet for 7" or 10", \$5; Philco sig. gen., \$20. OIA, 27, 57, 58, 12A, 71A—15c and 20c. Audel Radio Guide, \$1.50. J. Leach, 2327 Germantown Ave., Philadelphia, Pa.

**TRADE**—Webster wire recorder mechanism complete, latest model, never used. Want communication or amateur receiver. H. William Propsner, R.F.D., Rushland, Pa.

**FOR SALE**—Model A-200 approved sig. gen., \$27.50; BC-645 dynamotor. Also transformer and choke for A.C. conversion. Best offer. Robert Martin, Umatilla, Fla.

**WANTED**—Practical training in teletype operation, maintenance and repair. C. C. Krueger, Box 612, Buhl, Minn.

**WANTED**—Defective 100TH, 250TH, 450TH and 450TH tubes. What have you? Byron Stamate, 2950 Sycamore St., Martinez, Calif.

**FOR SALE OR SWAP**—Radio City VOM model 442, complete with leads and instructions, \$10; 28D7 tube, \$1. Or will trade for radio parts. MacRabie's Radio Shop, Franklin, N. Y.

**WANTED**—N.R.I. radio and TV course, all lessons. Will pay cash or trade 1200A Triplet voltmeter. Ellison Radio Service, 211 West Main St., Sedalia, Mo.

**WANTED**—T47/ART-13 Collins transmitter, power unit, mounts. Must be reasonable, repairable, or serviceable, all or part. Airway Radio-Electric, Pinellas Airport, St. Petersburg, Fla.

**TRADE**—Leeds and Northrup bridge; also misc. radio parts. Want tube tester and communication receiver. T. A. Koss, 11-235 Exeter Rd., Carleton, Mich.

**FOR SALE**—Stephens P-15 high freq. unit and 814H horn, 800X crossover network, 103LX 15" low freq. speaker; Jensen 18" dynamic speaker; UTC LS-33 line transformer. Donald Keiser, Gladbrook, Iowa

**WANTED**—New ham needs a start. Can't afford new equip. Appealing to fellow hams for junk box extras, as transformers, meters, etc. John Morrice, 167 Myrtle Ave., Staten Island 10, N. Y.

**SWAP**—For test or electronic equip., one 8mm German autoloading rifle. Munson's Radio Shop, Pembroke, Me.

**FOR SALE OR TRADE**—BC624, BC454, BC-453 receivers; GE H-32 rec. AM with walnut cabinet; Bausch Lomb microscope. Want typewriter, 10 meter converter, oscilloscope. Glenn Troxel, Verona, Ill.

**WANTED**—1847, 5527, or similar type iconoscope. Give condition and price. Bob Mahrenholz, 3014 E. Gum St., Evansville 14, Ind.

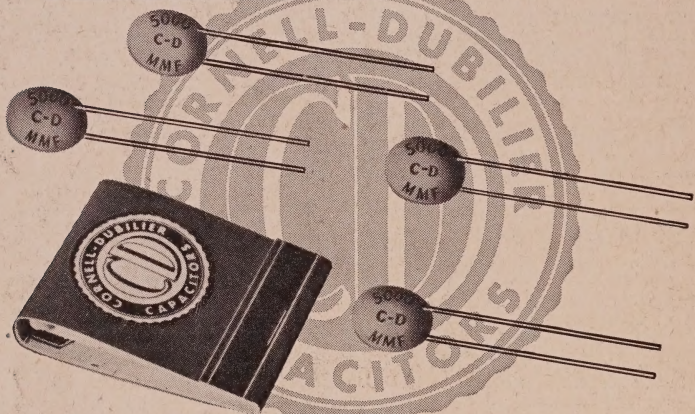
**FOR SALE**—Webster wire recorder, cost \$150, sell for \$105. Rev. R. S. Komp, Drawer 32, Meridian, N. Y.

**WANTED**—Hickok TV sig. gen. model 610-A, Precision tester model 85. What have you to trade or sell? Luther Cansler, Kings Mountain, N. C.

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